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UNITED STATES DEPARTMENT OF COMMERCE
National Telecommunications and
Information Administration
Washington, D.C. 20230

WT Docket No. 99-168

January 5, 2000

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Mr. Thomas Sugrue
Chief, Wireless Telecommunications Bureau
Federal Communications Commission
Washington, D.C. 20554

Dear Mr. Sugrue:

The National Telecommunications and Information Administration (NTIA) appreciates this opportunity to review and comment on the Federal Communications Commission's (Commission) Report and Order (R&O) in the matter of the service rules for the 746-764 and 776-794 MHz bands, and revisions to Part 27 of the Commission's rules.¹ NTIA shares concerns raised by several public safety organizations regarding the out-of-band emission limits established to protect public safety receivers in the 764-776 MHz and 794-806 MHz bands. These bands are to be used for the development of systems to support nationwide interoperability between Federal, State, and Local law enforcement agencies.² NTIA is also concerned with the out-of-band emission limits that are established to protect the 1559-1610 MHz radionavigation satellite service band that is used by the Global Navigation Satellite System (GNSS).

The version of the R&O dated December 7, 1999 was discussed at the Interdepartment Radio Advisory Committee (IRAC) meeting on December 14. As a result of several *ex parte* filings,³ the Commission has modified the limits on out-of-band emissions in the 764-776 MHz and 794-806 MHz public safety bands from transmitters operating in the 746-764 MHz and 776-794 MHz bands. The modifications to the out-of-band emission limits are contained in the version of the R&O dated December 28, 1999. The following paragraphs address: the limits on out-of-band emissions in the 764-776 MHz and 794-806 MHz public safety bands; and the limits on out-of-band emissions in the 1559-1610 MHz radionavigation satellite service band.⁴

¹ A first version of the R&O was received on December 7, 1999 and a second version was received on December 28, 1999. Comments will be provided on both versions.

² Comments, WT Dkt. No. 99-168: The Association of Public Safety Officials-International, Inc. (Nov. 16, 1999); National Coordination Committee (Nov. 26, 1999).

³ *Ex Parte* Comments, WT Dkt. No. 99-168: Motorola, Inc. (Dec. 13, 1999); FreeSpace Communications (Dec. 16, 1999); The Association of Public-Safety Communications Officials-International, Inc. (Dec. 16, 1999); and Federal Law Enforcement Wireless Users Group (Dec. 9, 1999).

⁴ The proposed modifications for the out-of-band emission limits in the 1559-1610 MHz were previously sent to the Commission in a draft letter (December 16, 1999) as part of the coordination of the version of the R&O dated December 7, 1999. The proposed modifications were incorporated in the version of the R&O dated December 28, 1999.

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I. OUT-OF-BAND EMISSION LIMIT PROPOSAL FOR TRANSMITTERS OPERATING IN THE 746-764 MHz AND 776-794 MHz BANDS

In the version of the R&O dated December 28, 1999, the Commission has proposed the following effective radiated power (ERP) and out of band emission limits for transmitters operating in the 746-764 MHz and 776-794 MHz bands:

BAND	STATION TYPE	ERP LIMIT	OUT-OF-BAND EMISSION LIMIT
746-764 MHz	Base	1000 W	$76 + 10 \text{ Log (Power)}$
776-794 MHz	Mobile and Control Portable	30 W 3 W	$65 + 10 \text{ Log (Power)}$

As shown in attached analysis, when there is a commercial base transmitter or a public safety base receiver in the scenario the distance separation that is required to preclude interference to a public safety receiver can be relatively large. This is especially true when the commercial transmitter has a low power (*e.g.*, minimum attenuation of the out-of-band emissions) in combination with a high antenna gain. In order to protect public safety receivers under these conditions NTIA recommends the following out-of-band emission limits for transmitters operating in the 746-764 MHz and 776-794 MHz bands:

For commercial base transmitters operating in the 746-764 MHz band:

- on all frequencies between 764-776 MHz the power of any emission shall be attenuated below the transmitter power by at least $80 + 10 \text{ Log (Power)}$;
- on all frequencies between 794-806 MHz the power of any emission shall be attenuated below the transmitter power by at least $80 + 10 \text{ Log (Power)}$.

For commercial mobile, control, and portable transmitters operating in the 776-794 MHz band:

- on all frequencies between 764-776 MHz the power of any emission shall be attenuated below the transmitter power by at least $65 + 10 \text{ Log (Power)}$;
- on all frequencies between 794-806 MHz the power of any emission shall be attenuated below the transmitter power by at least $70 + 10 \text{ Log (Power)}$.

A measurement bandwidth of 6.25 kHz consistent with the channel bandwidth for public safety receivers should be used for all out-of-band emission measurements in the 764-776 MHz and 794-806 MHz bands.

II. GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS) PROTECTION LIMITS

In Paragraph 161 of the version of the R&O dated December 7, 1999, the Commission describes the out-of-band emission limits required to protect GNSS operations. NTIA proposes to include a footnote to explain what the out-of-band emission limits include:

In addition, we sought comment on the impact of imposing the out-of-band emission limits proposed by NTIA on the design of equipment for use in the 776-794 MHz band. Noting that stringent out-of-band emissions ("OOBE")^{FN} limits are generally more difficult to meet for mobile and hand-held transmitters than for base and control stations or for fixed service stations, we sought information on how our proposal might affect the cost, size, weight, and battery life for handheld or portable equipment, and whether the proposal could severely curtail the availability of the 36 megahertz of spectrum designated by Congress for commercial use.³⁷¹

FN The out-of-band emissions include both spurious and harmonic emissions.

In Paragraph 163 of the version of the R&O dated December 7, 1999, the Commission proposes out-of-band emission limits to protect GNSS operations when used for precision approach and landings. The limits adopted by the Commission are consistent with those proposed by NTIA.⁵ However, NTIA proposes the following modifications to the paragraph in order to more accurately reflect the NTIA proposal:

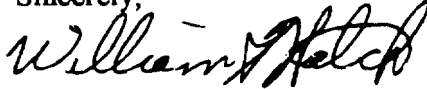
We are committed to ensuring that the GNSS is protected adequately against interference. We are also committed to not adopting OOBE limits on equipment operating in the 776-794 MHz band that could effectively prohibit the use of this band by new commercial licensees, and will enable such licensees to implement new services in a timely manner. As discussed below, we believe that the proposed OOBE limits provide the appropriate balance to meet the needs of both of these competing requirements. Thus, we adopt the following OOBE limits for all spurious emissions including harmonics that fall within the 1559-1610 MHz frequency range, from equipment operating in the 746-764 MHz and 776-794 MHz bands: (1) for wideband emissions, -70 dBW/MHz equivalent isotropically radiated power (EIRP); and (2) ~~for narrowband emissions, -80 dBW/700 Hz. Further, as proposed in the NPRM, we also adopted an absolute limit of -80 dBW on the EIRP. Further, as proposed in the NPRM, we also adopt an absolute limit of -80 dBW on the EIRP of~~

⁵ Letter from William T. Hatch, Acting Associate Administrator, Office of Spectrum Management, NTIA, to Chief, Office of Engineering and Technology, FCC, May 11, 1999.

~~discrete emissions of less than 700 Hz bandwidth, rather than a limit on narrowband spectral power density for discrete emissions of less than 700 Hz bandwidth, an absolute EIRP limit of -80 dBW.~~³⁷⁷ Outside of emissions into the 1559-1610 MHz GNSS RNSS band, the OOB standards adopted in Section III.D.2 will apply.³⁷⁸

If you have any questions regarding these proposals, please do not hesitate to contact me at (202) 482-1850.

Sincerely,



William T. Hatch
Acting Associate Administrator
Office of Spectrum Management

Enclosure

ENCLOSURE

INTRODUCTION

The Commission's current proposal for the effective radiated power (ERP) and out-of-band emission limits for the transmitters operating in the 746-764 MHz and 776-794 MHz bands is shown in Table 1.

TABLE 1.

BAND	STATION TYPE	ERP LIMIT	OUT-OF-BAND EMISSION LIMIT
746-764 MHz	Base	1000 W	$76 + 10 \log (\text{Power})$
776-794 MHz	Mobile/Control Portable	30 W 3 W	$65 + 10 \log (\text{Power})$

Mobile, control, and portable station transmitters are not permitted in the 746-764 MHz band.

If it is assumed that the 764-776 MHz is used for public safety base-to-mobile transmissions and the 794-806 MHz band is used for public safety mobile-to-base transmissions, there are four interference scenarios that should be considered:

- commercial base transmitter to public safety mobile/portable receiver;
- commercial mobile/control/portable transmitter to public safety base receiver;
- commercial mobile/control/portable transmitter to public safety mobile/portable receiver;
- commercial base transmitter to public safety base receiver.

The analysis in this document will assess whether the out-of-band emission limits proposed by the Commission will protect public safety receivers from interference in each of the scenarios identified above.

ANALYSIS METHODOLOGY

The interfering signal power level (I) from the commercial transmitters at the input to a public safety receiver is found using the following equation:

$$I = ERP - P_{OOB} + G_R - L_P - L_c \quad (1)$$

where

ERP is the effective radiated power density of the commercial transmitter (dBm/6.25 kHz);

P_{OOB} is the attenuation of the out-of-band emissions of the commercial transmitter (dB);

G_R is the public safety receiver antenna gain (dBd);

L_P is the propagation loss between the commercial transmitter and the public safety receiver (dB);

L_c is the cable/insertion loss of the commercial transmitter (dB).

Solving Equation 1 for the propagation loss yields:

$$L_P = ERP - P_{OOB} - I + G_R - L_c \quad (2)$$

If the public safety receiver threshold is substituted into Equation 2, this will give the propagation loss that is required to preclude interference. An interference threshold of -134 dBm will be used in this analysis for the public safety receivers.⁶

From the propagation loss computed in Equation 2, the distance separation required to preclude interference to a public safety receiver can be determined from the equation below:

$$20 \log D_{Sep} = L_P - 20 \log F - 32.45 - L_{clutter} \quad (3)$$

where

F is the frequency of the commercial transmitter (MHz);

D_{Sep} is the distance separation between the commercial transmitter and the public safety receiver that is required to preclude interference (km);

L_{clutter} is the local clutter loss attenuation factor (dB).

To determine whether the proposed out-of-band emission limits are adequate to protect public safety receivers, the potential for interference will be expressed in terms of the distance separation that is required to preclude interference.

ANALYSIS OF COMMERCIAL BASE TRANSMITTER OUT-OF-BAND EMISSIONS TO A PUBLIC SAFETY MOBILE/PORTABLE RECEIVER

⁶ *Ex Parte* Comments, WT Dkt. No. 99-168: Motorola Inc. (Dec. 2, 1999); FreeSpace Communications (Nov. 24, 1999); and Federal Law Enforcement Wireless Users Group (Dec. 9, 1999).

As shown in Table 1, for the commercial base transmitters operating in the 746-764 MHz band there is a maximum ERP limit of 1000 Watts. The out-of-band emissions for the base transmitters are to be attenuated below $76 + 10 \log(\text{Power})$. To evaluate whether the proposed out-of-band emission limit is adequate to protect a public safety mobile/portable receiver the combinations of commercial base transmitter power (P) and antenna gain (G) shown below will be considered:

Case A	P = 1000 W	G = 0 dBd
Case B	P = 50 W	G = 13 dBd
Case C	P = 10 W	G = 20 dBd

The assumptions used in this analysis include:

- 2 dB system loss for the commercial base transmitter;
- 0 dBd antenna gain for the public safety mobile/portable receiver;
- center frequency of 755 MHz for the propagation loss calculations;
- 1.25 MHz bandwidth for the base transmitter;
- 5 dB of clutter loss.

The distance separations that are required to preclude interference to a public safety mobile/portable receiver using the out-of-band emission limit for commercial base transmitters proposed by the Commission are given in Table 2.

TABLE 2.

ANALYSIS CASE	DISTANCE SEPARATION REQUIRED TO PRECLUDE INTERFERENCE
Case A	25 m
Case B	113 m
Case C	250 m

ANALYSIS OF COMMERCIAL MOBILE/CONTROL TRANSMITTER OUT-OF-BAND EMISSIONS TO A PUBLIC SAFETY BASE RECEIVER

As shown in Table 1, for the commercial mobile/control and portable transmitters operating in the 776-794 MHz band there is a maximum ERP limit of 30 Watts and 3 Watts respectively. The out-of-band emissions for the mobile/control and portable transmitters are to be attenuated below $65 + 10 \log(\text{Power})$. To evaluate whether the proposed out-of-band emission limit is adequate to protect a public safety base receiver the combinations of commercial mobile/control transmitter power (P) and antenna gain (G) shown below will be considered:

Case A	P = 30 W	G = 0 dBd
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Case B	P = 15 W	G = 3 dBd
Case C	P = 3 W	G = 10 dBd

Given the low ERP limit proposed for portable transmitters the interference to a public safety receiver is not believed to be a problem and will not be considered in this analysis.

The assumptions used in this analysis include:

- 2 dB system loss for the commercial mobile/control transmitter;
- 10 dBd antenna gain for public safety base receiver;
- 1.25 MHz bandwidth for the commercial mobile/control transmitter;
- center frequency of 784 MHz for the propagation loss calculations;
- 5 dB of clutter loss.

The distance separations that are required to preclude interference to a public safety base receiver using the out-of-band emission limit for commercial mobile/control transmitters proposed by the Commission are given in Table 3.

TABLE 3.

ANALYSIS CASE	DISTANCE SEPARATION REQUIRED TO PRECLUDE INTERFERENCE
Case A	268 m
Case B	383 m
Case C	857 m

ANALYSIS OF COMMERCIAL MOBILE/PORTABLE TRANSMITTER OUT-OF-BAND EMISSIONS TO A PUBLIC SAFETY MOBILE/PORTABLE RECEIVER

As shown in Table 1, for the commercial mobile/control and portable transmitters operating in the 776-794 MHz band there is a maximum ERP limit of 30 Watts and 3 Watts respectively. The out-of-band emissions for the mobile/control and portable transmitters are to be attenuated below $65 + 10 \log(\text{Power})$. To evaluate whether the proposed out-of-band emission limit is adequate to protect a public safety mobile/portable receiver the combinations of commercial mobile/control transmitter power (P) and antenna gain (G) shown below will be considered:

Case A	P = 30 W	G = 0 dBd
Case B	P = 15 W	G = 3 dBd
Case C	P = 3 W	G = 10 dBd

Given the low ERP limit proposed for commercial portable transmitters the interference to a public safety receiver is not believed to be a problem and will not be considered in this analysis.

The assumptions used in this analysis include:

- 2 dB system loss for the commercial mobile/control transmitter;
- 0 dBd antenna gain for public safety mobile/portable receiver;
- 1.25 MHz bandwidth for the commercial mobile/control transmitter;
- center frequency of 784 MHz for the propagation loss calculations;
- 10 dB of clutter loss.

The distance separations that are required to preclude interference to public safety mobile/portable receivers using the out-of-band emission limit for commercial mobile/control transmitters proposed by the Commission are given in Table 4.

TABLE 4.

ANALYSIS CASE	DISTANCE SEPARATION REQUIRED TO PRECLUDE INTERFERENCE
Case A	49 m
Case B	68 m
Case C	152 m

ANALYSIS OF COMMERCIAL BASE TRANSMITTER OUT-OF-BAND EMISSIONS TO A PUBLIC SAFETY BASE RECEIVER

As shown in Table 1, for the commercial base transmitters operating in the 746-764 MHz band there is a maximum ERP limit of 1000 Watts. The out-of-band emissions for the base transmitters are to be attenuated below $76 + 10 \log(\text{Power})$. To evaluate whether the proposed out-of-band emission limit is adequate to protect a public safety base receiver the combinations of commercial base transmitter power (P) and antenna gain (G) shown below will be considered:

Case A	P = 1000 W	G = 0 dBd
Case B	P = 50 W	G = 13 dBd
Case C	P = 10 W	G = 20 dBd

The assumptions used in this analysis include:

- 2 dB system loss for the commercial base transmitter;
- 10 dBd antenna gain for the public safety base receiver;
- center frequency of 755 MHz for the propagation loss calculations;
- 1.25 MHz bandwidth for the base transmitter.

The distance separations that are required to preclude interference to a public safety base receiver using the out-of-band emission limit for commercial base transmitters proposed by the Commission are given in Table 5.

TABLE 5.

ANALYSIS CASE	DISTANCE SEPARATION REQUIRED TO PRECLUDE INTERFERENCE
Case A	140 m
Case B	634 m
Case C	1.4 km

PROPOSAL FOR THE OUT-OF BAND EMISSIONS LIMITS OF COMMERCIAL TRANSMITTERS OPERATING IN THE 746-764 MHz AND 776-794 MHz BANDS

As shown in Tables 2 , 3, and 5 when there is a commercial base transmitter or a public safety base receiver in the scenario the distance separation that is required to preclude interference to a public safety receiver can be relatively large. This is especially true for cases when the commercial transmitter has a low power (e.g., minimum attenuation of the out-of-band emissions) in combination with a high antenna gain. In order to protect public safety receivers under these conditions the following out-of-band emission limits are being proposed for commercial base, mobile, control, and portable transmitters operating in the 746-764 MHz and 776-794 MHz bands:

For commercial base transmitters operating in the 746-764 MHz band:

- on all frequencies between 764-776 MHz the power of any emission shall be attenuated below the transmitter power by at least $80 + 10 \text{ Log (Power)}$;
- on all frequencies between 794-806 MHz the power of any emission shall be attenuated below the transmitter power by at least $80 + 10 \text{ Log (Power)}$.

For commercial mobile, control, and portable transmitters operating in the 776-794 MHz band:

- on all frequencies between 764-776 MHz the power of any emission shall be attenuated below the transmitter power by at least $65 + 10 \text{ Log (Power)}$;
- on all frequencies between 794-806 MHz the power of any emission shall be attenuated below the transmitter power by at least $70 + 10 \text{ Log (Power)}$.

A measurement bandwidth of 6.25 kHz consistent with the channel bandwidth for the public safety receivers should be used for all out-of-band emission measurements in the 764-776 MHz and 794-806 MHz bands.